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10/062,687	01/30/2002	Hiroyuki Okuyama	113278-005	2178
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BELL, BOYD & LLOYD, LLC P. O. BOX 1135 CHICAGO, IL 60690-1135			EXAMINER DOLAN, JENNIFER M	
			ART UNIT	PAPER NUMBER
			2813	
DATE MAILED: 01/23/2004				

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/062,687

Applicant(s)

OKUYAMA ET AL.

Examiner

Jennifer M. Dolan

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 12 June 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-82 is/are pending in the application.
- 4a) Of the above claim(s) 18-21, 37-40, 52-67 and 80-82 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-9, 11-17, 22-31, 34-36, 41-44, 46-51 and 68-79 is/are rejected.
- 7) ☒ Claim(s) 10, 32, 33, 45 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 January 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☒ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3,4,7,9.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Election/Restrictions*

1. Applicant's election without traverse of Group I, claims 1-17, 22-36, 41-51, and 68-79 in Paper No. 11 is acknowledged. Accordingly, claims 18-21, 37-40, 52-67, and 80-82 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention.

### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-9, 11-14, 22-28, 30, 31, 68-75, and 77-79 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,320,209 to Hata et al.

As the claims are directed to a light emitting device, per se, the method limitations appearing in claims 4-7, 25-28, 51, 77, and claim 41, line 4; claim 68, line 4; claim 76, lines 2-3; and claim 78, line 4 have only been accorded weight to the extent that it affect the structure of the completed light emitting device. Note that "determination of patentability in 'product-by-

process' claims is based on product itself, even though such claims are limited and defined by process [i.e., "selective growth"], and thus product in such claim is unpatentable if it is the same as, or obvious form, product of prior art, even if prior product was made by a different process", *In re Thorpe, et al.*, 227 USPQ 964 (CAFC 1985). Furthermore, note that a "product-by-process claim, although reciting subject matter of claim in terms of how it is made [i.e., "selective growth"] is still product claim; it is patentability of product claimed and not recited process steps that must be established, in spite of fact that claim may recite only process limitations", *In re Hirao and Sato*, 190 USPQ 685 (CCPA 1976). For the purpose of examination, "selective growth"-based steps have only been accorded weight to the extent that the device has the proper physical structures to make selective growth possible.

Regarding claims 1, 8, 9, 22, 31, 68, and 70, Hata discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane (column 4, lines 34-40); a crystal layer (105-109) with a crystal surface comprising a hexagonal pyramid oriented along an S-plane (column 6, lines 65-67; figure 6c); first and second conductive layers (109, 111 or 106), and an active layer (107), all formed along a portion of the crystal surface. Hata further discloses a layer of a first conductivity type (106) and a layer of a second conductivity type (109) formed along the hexagonal pyramid. Hata even further discloses that an area of the active layer is larger than an area of the window region (figures 6A-6C), and that the area of the active layer is larger than the sum of the projection of the active layer and the area through which an electrode (112) adjoins a contact layer (see figure 6c).

Regarding claims 2, 3, 13, 23, 24, 69, and 73-75, Hata discloses that the crystal layer is a nitride semiconductor material, GaN/InGaN, which has a wurtzite crystal structure and is a “substantially symmetrical hexagonal structure” (column 5, lines 25-50).

Regarding claims 4-7, 25-28, 71, and 77, Hata discloses a selective growth arrangement (figure 6c), with a material layer capable of growth (103) interposed between the substrate and the grown layer (figure 6c), with a masking layer (104) having openings through which the crystal layer grows (figures 6A-6C), and where the crystal layer extends laterally from the opening in the masking layer (figures 6B-6C).

Regarding claims 11 and 30, Hata discloses that a current flows through the active region (column 5, lines 60-67).

Regarding claim 12, Hata discloses that the active layer is InGaN (column 5, lines 37-50).

Regarding claim 72, Hata discloses electrodes (112, 111) connected to the conductive layers for injecting current into the active region (column 5, lines 63-67).

Regarding claims 14 and 78, Hata discloses a device comprising: a substrate oriented along a c-plane (column 4, lines 34-40); an active layer (107) disposed between first and second conductive layers (109, 106), where a portion of the active layer (center portion, between the two pyramids; see figure 7c, figure 6c) is directed away from the active layer plane towards the substrate.

4. Claims 1-9, 12-14, 22-29, 68-71, 73-75, 77, and 78 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,981,977 to Furukawa et al (cited by applicant).

Regarding claims 1, 8, 9, 22, 29, 68, and 70, Furukawa discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane/ C+ plane (column 8, lines 6-11; principal plane of sapphire is a c+ plane); a crystal layer (112) with a crystal surface oriented along an S-plane (figure 4d); first and second conductive layers of first and second conductivity types (112 and 116), and an active layer therebetween (114), all formed along a portion of the crystal surface (figure 4d). Furukawa even further discloses that an area of the active layer is larger than an area of the window region (figures 4d).

Regarding claims 2, 3, 12, 13, 23, 24, 69, and 73-75, Furukawa discloses that the crystal layer is a nitride semiconductor material, InGaN, which has a wurtzite crystal structure and is a “substantially symmetrical hexagonal structure” (column 9, lines 1-5).

Regarding claims 4-7, 25-28, 71, and 77, Furukawa discloses a selective growth arrangement (figures 4 and 5), with a material layer capable of growth (103) interposed between the substrate and the grown layer (figures 4a-4d), with a masking layer (111) having openings (111A) through which the crystal layer grows (figures 4 and 5), and where the crystal layer extends laterally from the opening in the masking layer (figures 4 and 5).

Regarding claims 14 and 78, Furukawa discloses a device comprising: a substrate oriented along a c-plane (column 8, lines 6-11); an active layer (114) disposed between first and second conductive layers (112, 116), where a portion of the active layer (center portion, between the two pyramids; see figure 4d) is directed away from the active layer plane towards the substrate.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 41-44 and 46-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Furukawa et al. in view of U.S. Patent No. 5,814,839 to Hosoba.

Regarding claims 41, 43, 44, and 46, Furukawa discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane (column 8, lines 6-11); a crystal layer (112) oriented along an S-plane (figure 4d); first and second conductive layers of first and second conductivity types (112 and 116), and an active layer therebetween (114), all formed along a portion of the crystal surface (figure 4d).

Furukawa fails to teach a reflecting region formed parallel to the crystal surface and having at least two planes that intersect with an angle less than 180 degrees.

Hosoba discloses a light emitting device having a reflecting region (109, 120) that corresponds to the shape of an active region (3,33; see figs 8 and 17), and thus has at least two planes meeting at an angle of less than 80 degrees.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to include in the light emitting device of Furukawa the reflecting layer taught by Hosoba. The rationale is as follows: A person having ordinary skill in the art would have been motivated to provide a reflecting layer below the active region, because Hosoba shows that doing so improves the light extraction efficiency of the LED (Hosoba, column 27, lines 20-30).

Regarding claims 42, and 47-49, Furukawa discloses that the crystal layer is a nitride semiconductor material, InGaN, which has a wurtzite crystal structure (column 9, lines 1-5).

Regarding claim 50, Furukawa discloses that the active layer is entirely contained within a single device, and thus must be separated for each device (figures 4-6).

Regarding claim 51, Furukawa discloses a selective growth arrangement (figures 4 and 5), with a material layer capable of growth (103) interposed between the substrate and the grown layer (figures 4a-4d), with a masking layer (111) having openings (111A) through which the crystal layer grows (figures 4 and 5), and where the crystal layer extends laterally from the opening in the masking layer (figures 4 and 5).

7. Claims 15-17, 34-36, and 76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. in view of U.S. Patent No. 5,732,098 to Nisitani et al.

Regarding the claims, Furukawa discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane (column 8, lines 6-11); a crystal layer (112) with a crystal surface oriented along an S-plane (figure 4d); first and second conductive layers of first and second conductivity types (112 and 116), and an active layer therebetween (114), all formed along a portion of the crystal surface (figure 4d). Furukawa further discloses that the active layer is entirely contained within a single device, and thus must be separated from any adjacent devices (figures 4-6).

Furukawa fails to specify that the light emitting device is part of a display with plural light emitting devices.



Nisitani discloses an array with a plurality of light emitting diode devices (figures 14). All of the light emitting devices are wired in an array, and thus are responsive to an identical signal (figures 14 and 15).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to specify that the light emitting device of Furukawa is part of an array of plural devices, as suggested by Nisitani. The rationale is as follows: A person having ordinary skill in the art would have been motivated to provide a plurality of devices, so that the light emitting devices could be arranged in a matrix in order to provide an image display (Nisitani, column 14, lines 20-37).

8. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. in view of the Applied Physics Letters v(76) n(22) to Tachibana (cited by applicant).

Furukawa discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane (column 8, lines 6-11); a crystal layer (112) with a crystal surface oriented along an S-plane (figure 4d); first and second conductive layers of first and second conductivity types (112 and 116), and an active layer therebetween (114).

Furukawa fails to disclose that the active region is formed in the shape of hexagonal pyramid.

Tachibana discloses that it is advantageous to use an array of hexagonal pyramids as the active layer of a nitride-based light emitting device (figure 1a-1c).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the active layer of Furukawa, such that it includes the hexagonal pyramids

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taught by Tachibana. The rationale is as follows: A person having ordinary skill in the art would have been motivated to use hexagonal pyramids, because Tachibana shows that such structures have lower threshold currents than typical quantum well lasers (see Tachibana, page 1, column 1).

***Allowable Subject Matter***

9. Claims 10, 32, 33, and 45 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 10 and 45, although the prior art, such as U.S. Patent No. 6,252,255 to Ueta et al. suggests that it is advantageous to have some degree of inclination of a crystal face upon which growth is to be performed, Ueta tends to teach that inclinations above about 1 degree lead to surface roughness and bad crystal growth. Regarding claim 33, the prior art does not suggest forming an active layer in the shape of a hexagonal prismoid, but rather only teaches full hexagonal pyramid-shapes or S- faced ridge shapes. It is the examiner's opinion that since it is generally difficult to grow nitride or any hexagonal-lattice light emitting crystal structures with good growth quality and a low defect density, any significant changes to the growth procedure or the expected resultant shape would not have been obvious to one skilled in the art.

Regarding claim 33, there is no suggestion in the prior art of having a hexagonal pyramid shaped active layer with a decreased current density near the apex. Since in order to achieve this reduced current density, a portion of the electrode overlying the apex must be

removed from the structure, and since the prior art only teaches structures in which the top electrode completely covers the slant or central portions of the active layer, it is the examiner's opinion that such a modification would not have been obvious.

### ***Conclusion***

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- a. U.S. Patent No. 5,727,008 to Koga discloses an active region with a slant facet corresponding to the S-plane.
- b. U.S. Patent No. 5,828,008 to Mauk discloses advantages to including a reflective layer underneath an active layer for various light emitting device structures.
- c. U.S. Patent No. 6,252,255 to Ueta discloses some general principles of the effects of substrate inclination on MOCVD nitride growth.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (703) 305-3233 until 2/6/04, and (571)272-1690 thereafter. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (703) 308-4940. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Jennifer M. Dolan  
Examiner  
Art Unit 2813

jmd

*Carl Whitehead, Jr.*  
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